

## Assessment Means Form: Problem Solving

**Assessment Overview:** Teachers should aim to assess students in the most naturalistic environment first (i.e., observation) before moving on to more intentionally structured activities (i.e., the Situation).

**What Teachers Need to Know and Observe:** The purpose of this progression is to assess children's problem solving abilities, not their perseverance, engagement, or social problem solving skills. The best atmosphere for authentic problem solving is a risk-free classroom environment that allows for teacher-child and child-to-child interaction, creativity, and open-ended activities. Teachers should look for opportunities to observe the child interacting with problems in a variety of content areas (e.g., writing, math, etc.). The child should demonstrate a skill across problems in more than one content area to be placed at a specific skill level.

Evidence should only be collected:

- when a child is interacting with an academic problem (see definition on page 2).
- when a child is attempting to solve problems that are at an appropriate instructional level. Problems at the appropriate instructional level are within the child's ability range, somewhere just beyond "not challenging" problems that the child can easily solve independently to the upper boundary of "most challenging" problems that the child can solve but only with adult guidance (i.e., within the child's zone of proximal development).
- when a child is experiencing a typical day.

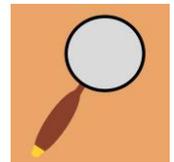
Evidence should NOT be collected:

- when children are interacting with problems that are clearly beyond their ability level.
- on an atypical day (e.g., when a child is dealing with a significant emotional experience or when a child is under the weather).

**General Teacher Instructions:** When being assessed around problem solving, children should come up with their own ideas; however, they should be encouraged to talk with one another. In collaborative problem solving activities, children will be more likely to verbalize their thinking, allowing teachers to capture children's metacognitive thinking. Teachers should not suggest approaches, procedures, or strategies to use for a specific problem until after documenting child's performance. However, teachers may ask questions as needed and as appropriate to elicit evidence to determine the child's level on the progression. In general, open-ended questions, rather than close-ended questions (which can often be leading), should be used to probe children's thinking. Some examples of questions include the following:

### Skills A-J

- Do you have all the materials you need?
- Would you like to hear the instructions again?
- Do you have any questions about the activity?
- Are you ready to start?
- Think about how you have solved other problems like this.
- Can you think of other problems you have solved that are similar to this one?
- Have you seen a problem like this before?
- Is there anything about this problem that you already know?
- What do you know about \_\_\_\_\_ (e.g., weather patterns) that can help you solve this problem?
- Are there any other tools you would like to use that are not already here?



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- What is working well for you? What is not working?
- How did you decide to solve the problem this way?
- Tell me about more about some of the choices that you made.
- Tell me about your plan.

### Skills H, I, J

- Are there other strategies you could use?
- Remember, sometimes you can solve a problem in different ways.
- Is there a different way for you to solve this problem?
- Remember, sometimes problems have more than one answer/solution."

### Skill J

Why do you think that is the best way to solve this problem?

### Key Terms:

- **Academic problem:** A problem that includes academic content (e.g., math, English/language arts, social studies, science, healthful living, music, visual and performing arts, foreign language, physical education, technology). Academic problems are different from social-emotional problems (e.g., what should a child do when another person has an item that the child wants?).
- **Approach:** The set of procedures, concepts, and/or strategies a child applies in the process of attempting to solve a problem. An approach is what a child uses to reach a solution.
- **Concept:** A concept is universal, timeless, and abstract and moves children toward higher levels of thinking (Erickson, 2007, 2008, and 2011). A concept is a broad idea (e.g., patterns can repeat and increase at the same time) that transcends the perspectives and limits of any specific subject area (e.g., math, music, art, technology, physical education). A concept is something that can be taught in any classroom, no matter what the content includes. The concepts children understand are dependent on their ages, experiences, and cultural backgrounds. What is most important is that children are exposed to and explore the concepts (i.e., "big ideas") that cut across content areas.
- **Conceptual knowledge:** Knowledge about facts, principles, and relationships that can be generalized to various tasks (e.g., when putting together a puzzle with a beach and ocean, a child uses conceptual knowledge that fish live in the water: picking up a piece with a fish and putting it with the pieces showing the ocean). A child gains conceptual knowledge by making connections between ideas based on his/her experiences.
- **Familiar problem:** A type of problem a child has encountered in the current classroom or one a teacher can reasonably assume a child has encountered in a previous grade. A familiar problem is one that is similar to one that a child has seen before (e.g., adding two-digit numbers) but is not one for which the child already knows (has memorized) the solution/answer (e.g., knowing that 10 plus 20 equals 30).
- **Novel problem:** A type of problem that (1) a child has NOT encountered in the current classroom context AND one the teacher can reasonably assume the child has NOT encountered in a previous grade AND (2) requires a previously unused (i.e., non-routine) approach in order for it to be solved (e.g., For a child who has done a 20- piece square puzzle, a new 20- piece square puzzle is not a novel problem because it is solved the same way as another 20-



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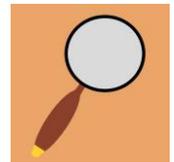
piece square puzzle; a 50- piece square puzzle is also not novel because it does not require a new procedure; a 20-piece round puzzle is novel - it requires a previously unused approach because the child cannot use corners or straight edges).

- **Procedural knowledge:** Knowledge about the STEPS required to complete a task (e.g., when putting together a puzzle, the child uses a learned procedure: sorting the puzzle pieces into ones with straight edges and ones without and then using the shapes of the pieces to complete the puzzle). Procedural knowledge can be learned by rote.
- **Procedure:** One or more steps that can be learned and used to complete a specific type of task (e.g., to find the area of a rectangle: identify the length and width then multiply them; To write a complete sentence: write a draft sentence, identify the noun and verb, capitalize the first letter of the sentence, and include punctuation).

**Observation Instructions:** Observe children throughout the day while engaging in academic problem solving activities, such as: (1) working with math manipulatives, (2) creating a storyline for dramatic play, (3) working in a bookmaking center, (4) putting together a puzzle, and (5) making a paper airplane.

Potential Opportunities for Observation	Potential Materials
Any setting where children are involved in academic problem solving activities (e.g., classroom, library, art room).	There are no specific materials required for this observation.

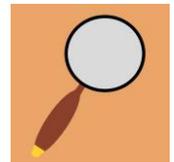
**Placing a Child on this Progression:** With all progressions, the goal is to identify the level at which the child is solidly performing. If the child is inconsistent at a given level, as children often are when they are learning a new skill, the correct placement is at a lower level. The teacher needs to collect enough evidence to be confident that the child is correctly placed on the progression. This will include multiple pieces of evidence where the child demonstrates the skill level at which he/she is placed and at least one documented instance of allowing the child the opportunity to demonstrate his/her skills/behavior at the next highest level. It will be difficult to place some children on a progression. Children who are not yet at Skill A should be marked as “Emerging” for that progression. Children who have reached the highest level of a progression should be marked at that highest level.



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### Observation Examples

Skill Progression	Observation Examples: Math	Observation Examples: Writing/Publishing	Observation Examples: Puzzles
<p><b>A.</b> Acknowledges that a problem exists without attempting to solve it (this may manifest as a child moving away from the problem).</p>	<p><i>Ms. Osses begins each day by posting a "Challenge Problem of the Day" for children to solve. Today's problem is "Look at the number 956. Show me how you would represent this using base ten blocks." Ben goes up to the board, points to each number, and reads it aloud, "Nine, five, and six." He watches other children working with the base ten blocks for a moment and then leaves the table.</i></p>	<p><i>Ira's class is in the media center looking for materials to support an upcoming writing project on recycling. Ira walks around the bookshelves and then selects a book about dogs. When Mrs. Caldwell checks in with Ira, he says to her, "I don't know anything about recycling, so I'm going to read this book instead."</i></p>	<p><i>Ren goes to the puzzle center and dumps a puzzle on the table. He looks at the pieces on the table, says, "This is too hard," and then walks away.</i></p>
<p><b>B.</b> Attempts to solve a problem by mimicking the motions and procedures of others OR seeking general support from others very early in the problem solving process (e.g., how do I do this? I don't know what to do.).</p>	<p><i>Jim sees Pragnya making stacks with her base ten blocks and mimics this behavior, but he does not understand her approach. Jim stacks the blocks randomly and is unable to represent 956.</i></p>	<p><i>Anushka is making a mini-book about clouds. Mrs. Caldwell has given the class cotton balls and has asked them to try and make the cotton balls match three different types of clouds (cumulus, stratus, cirrus). Anushka looks at what her friends are doing and starts stretching out the cotton balls in the same way that she sees the others doing.</i></p>	<p><i>Carter chooses a puzzle during center time. She is unsure how to fit the pieces in the frame correctly. Carter spends a few minutes watching another student, who also is putting together a puzzle. She watches and turns her puzzle pieces right side up - as the other child has done - but does not have an approach to complete the puzzle and moves to another center.</i></p> <p><i>Kathryn wants to put together a wooden puzzle. After trying to put two pieces together, she asks Su, "How do you get the pieces to fit?"</i></p>
<p><b>C.</b> Attempts to solve a problem using random trial and error.</p>	<p><i>Megan picks up a handful of tens and hundreds from the base ten blocks, shows them to her friend, Pragnya, and asks, "Is this right?" When Pragnya says it is not correct, Megan adds more tens and some ones and asks, "Is this right?"</i></p>	<p><i>Myer is working on a poster for Earth Day that supports the theme "Earth Day, Every Day!" Myer cuts out random magazine pictures that are off-topic. When Mrs. Caldwell asks Myer how his poster supports the theme, he says, "I don't know. I was just cutting out pictures that I liked."</i></p>	<p><i>At cleanup time, Candi finds a jigsaw puzzle that she knows needs to be put together so that it can be put away. She picks up pieces haphazardly, tries putting them together, then puts them down and repeats this process with other pieces without an approach for solving the puzzle. After working for several minutes,</i></p>



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			<i>Candi puts away the puzzle without completing it.</i>
<p><b>D.</b> Solves OR attempts to solve a familiar problem using procedures learned in previous problem solving experiences.</p>	<p><i>Alex gets a piece of paper, makes three columns, and labels them: hundreds, tens, and ones. In the hundreds column, he writes the number 9, in the tens column, he writes the number 5, and in the ones column, he writes the number 6. Then Alex counts out from the base ten blocks 9 hundreds, 5 tens, and 6 ones. When Ms. Osse asks Alex how he solved the problem, he says, "I remembered that you showed us how to make a table like this to find out how many of each type of block we need."</i></p>	<p><i>In the Bookmaking Center, Lashonda is making a book about her classmates (after previously making a book about her family). She begins writing about each classmate's favorite school activity. When Mrs. Caldwell asks how she came up with this idea, Lashonda says, "When I was making a book about my family, I wrote about each person's favorite food. So, I thought I would do something similar for my classmate book."</i></p>	<p><i>While putting together a wooden puzzle with the same number of pieces as puzzles he has solved before, George remembers to place the corners first and work next on the flat-sided border pieces. George is unable to complete the puzzle because this procedure doesn't work for the remaining pieces.</i></p> <p><i>Slater and Christy have worked together to complete a jigsaw puzzle. Slater used corners and colors as his problem solving approach, and he observed Christy using the picture on the box. Later, Slater uses corners, colors, AND the picture on the box as his approach to complete a similar puzzle.</i></p>
<p><b>E.</b> Solves OR attempts to solve a novel problem using procedures learned in previous problem solving experiences without demonstrating knowledge of why the procedure is or is not successful.</p>	<p><i>Thomas is practicing addition during Morning Math time. He looks through the cards to find a new kind of math problem. The problem on the card is <math>186 + 30 = \underline{\quad}</math>. Thomas knows how to solve 2-digit + 2-digit problems by grouping the tens, grouping the ones, and adding on. He decides to try the same plan to solve the new problem. His answer is 1116 (1+11+6). He looks at the answer on the back of the card and sees that it doesn't match. He retries solving several times, using the same procedure.</i></p>	<p><i>Mrs. Caldwell's class has been learning about how laws are passed at the local government level. She challenges her students to write a "law" that they would like to have at school. Jonathan writes about being able to sit where you want to in the cafeteria. He looks at the "Writing About Our Opinions" chart on the wall, and includes an opinion statement and provides reasons to support his opinion. Jonathan reads his writing aloud, and the class cheers and starts saying things like, "Yeah, we need that law!" Mrs. Caldwell asks Jonathan if he knows why his writing worked so well and has the students</i></p>	<p><i>During free choice centers, Lynne chooses tangrams for the first time because they look like puzzles to her. She selects a picture card with the shape of a house and uses the familiar strategy of moving around the pieces to complete the puzzle. She creates a shape that looks like a house, but it does not match the one on the card. Mr. Pellichero says, "You have used the square for the chimney. What two pieces make the rest of the roof?" Lynne is unable to select which pieces match the outline of the roof to complete the activity successfully.</i></p>



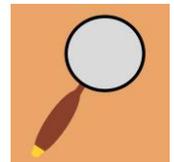
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		<p><i>excited, and he says, "I don't know. I just wrote what I was thinking."</i></p>	
<p><b>F.</b> States a hypothesis about how to solve a novel problem, using both concepts and procedures.</p>	<p><i>Ashley sits down next to Thomas as he tries to solve a flash card problem. She says, "Hey, these numbers are just like the numbers in today's Challenge Problem! I think if we make 186 and 30 with unit blocks and then count all the blocks, we can trade for bigger units and get the answer."</i></p>	<p><i>At the beginning of writing time, Mrs. Caldwell asks Juan what he is going to write about. Juan says, "My big sister had to do a book report. I'm going to write a report about the comic book I just read." When asked about his plan for writing the book report, Juan says, "I'm going to do the same thing as when we wrote about our opinions and had to write our opinion and a reason for our opinion. For my book report, I'm going to write about why I think the villain is not really evil. Everyone does bad things sometimes."</i></p>	<p><i>When confronted with a round jigsaw puzzle, Danielle combines her concept knowledge that rectangles have straight sides and circles have curved sides with her procedural knowledge of separating all the pieces with the same kind of edge. When Mr. Pellichero asks Danielle if she has a plan for completing the puzzle, she explains her hypothesis, saying, "I think that I can do this puzzle if I begin by separating all the pieces with a curved side."</i></p>
<p><b>G.</b> Solves OR attempts to solve a novel problem by connecting concepts and using familiar procedures.</p>	<p><i>Ms. Osses has given the class some "start unknown" problems for the first time. Tony knows how to form an equation for a "change unknown" problem. He uses this knowledge of the process to create an equation that he believes will work for the start unknown problem. He knows that to solve the change unknown problem "2 bunnies were on the grass, some more arrived, now there are 5," he can use the equation <math>2 + ? = 5</math>. For the start unknown problem of "Some bunnies were on the grass, 3 more arrived, now there are 8," he writes the equation <math>? + 3 = 8</math> and solves the problem successfully.</i></p>	<p><i>Orion is creating an informational flyer on the school's upcoming canned food drive. Although he has not created a flyer before, Orion says, "I remember that when we created an informational newsletter, we had to do research. I think our research needs to be on hunger because the food drive is to help people who are hungry." Orion then gets a copy of the newsletter plan and refers to it as he works to complete the flyer.</i></p>	<p><i>Dawson takes out a new 3D puzzle of a globe. He dumps out all the pieces, turns them right side up, and looks through the pieces for a minute. Then Dawson says, "Hey, there's no edge pieces." He looks more closely at the picture on the box and says, "Oh, it's a ball-shaped puzzle." He starts putting the pieces together, intermittently looking at the box for guidance. When Mr. Pellichero asks Dawson to tell him about his plan for solving the puzzle, Dawson says, "I'm using the picture on the box to know where the pieces go; just like I do with other puzzles. I also remember what we learned in class and that helps. Like I remember we learned about Africa and that it is below Europe so that helps me</i></p>



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<p><b>H.</b> Generates AND explains an alternate problem solving approach (including when an approach is not working).</p>	<p><i>Martin joins Ashley and Thomas and watches them as they make 186 and 30 with unit blocks, then put all the blocks in one group and count them. Martin says, "I have an idea. Why don't you put the blocks in a table like Ms. Osses showed us.?" Martin creates a table with columns for hundreds, tens, and ones. Then he puts the blocks for 186 on the top of the page and those for 30 on the bottom and says, "See, now we can see where the numbers carry over. In the ones, there are 6 from the top number and none from the bottom so that is just 6. In the tens, there are 8 in the top number and 3 in the bottom. If we add them, we get a hundred and 1 ten. So, the hundred moves into the hundreds column and just one ten stays in the tens column. Then we count the hundreds. So, we have 2 hundred, 1 ten, and 6 ones. That's 216!"</i></p>	<p><i>Beckett and Joe have been writing books together during free writing time. While studying transportation, Mrs. Caldwell overhears Beckett and Joe talking in the writing center about an idea for a new book about airplanes. Beckett says, "Let's make a book with pictures on each page so that when we flip the pages it looks like the airplane is flying. If each picture has only small changes, I think it will look like it does in a movie."</i></p>	<p><i>know where to put the pieces that say "Africa."</i></p> <p><i>Joe wants to put together a 3-D stegosaurus. He knows that the backbone of a stegosaurus goes from small pieces at the neck, to larger pieces on the back, to smaller pieces at the tail. When he attempts to build a stegosaurus with unit blocks, the blocks will not support each other from small to large to small. So, Joe tries building with plastic interlocking blocks and is successful. Joe explains that the unit blocks won't work because of the weight of the larger ones, but that plastic interlocking blocks work because locking together gives them stability.</i></p>
<p><b>I.</b> Generates AND explains multiple approaches for solving a problem.</p>	<p><i>Ms. Osses asks the class to come up with as many ways to make 12 as possible. Hilary generates and explains the following approaches: - "When you add one, you get the next highest number." In the math center, she uses linking plastic cubes and first makes a tower of 11 yellow cubes, 1 with a red cube, and then joins them together to make 12. - "You can put two even numbers together to make an even number." She uses linking</i></p>	<p><i>While Beckett and Joe are discussing ideas for a making a book on airplanes, Mrs. Caldwell overhears Beckett say, "Let's make a flip book or we can use that stop motion app that we used in class last week. Both would show airplanes moving."</i></p>	<p><i>Monique comes up to the table where Dawson is putting together a 3D globe puzzle and overhears him explain his plan for solving the puzzle to Mr. Pellichero. Monique says, "You can also use our class globe to see where each country goes on the globe. See, the picture on the box only shows half the globe. Our globe would let you see everything. Oh, or you could remember our 'Countries of the World'</i></p>



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	<p><i>plastic cubes to make two towers of six each, and then joins them together to make 12. - "I can divide the two towers of six in half." She does so to come up with three, three, three and three, and joins the four towers of three to make 12.</i></p>		<p><i>song. That would help you remember where the countries go too."</i></p>
<p><b>J.</b> Provides justification for why a chosen self- or peer-generated problem solving approach might be the most efficient one for solving a problem.</p>	<p><i>During a math lesson involving 2-digit + 2-digit problems, Ms. Osses asks the class if anyone can explain how they solved the problem <math>26 + 15</math>. Rea says, "I grouped by tens. <math>5 + 5</math> is 10; <math>10 + 10 + 20</math> is 40; <math>+1</math> is 41." Ms. Osses asks Rea to explain why she thinks that was the best way to solve the problem. Rea says, "It was quicker than counting on from 26 and faster than drawing 26 dots and 15 dots and counting them all."</i></p>	<p><i>While Beckett and Joe are discussing ideas for a making a book on airplanes, Mrs. Caldwell overhears Beckett say, "Let's make a flip book or we can use that stop motion app that we used in class last week. Both would show airplanes moving." Joe then says, "Let's use the stop motion app. With the flip book we'd have to draw the plane over and over; with the app we'd only need to draw the plane once."</i></p>	<p><i>The class is given a 3- D model of a dinosaur to assemble. Sandy recognizes that the model is a new kind of puzzle. She can tell from the picture of the completed model that the pieces of the dinosaur's backbone are all shaped the same, but are different sizes. Sandy separates all the pieces that form the dinosaur's backbone, using the same strategy that helps her solve jigsaw puzzles. She explains that her sorting the pieces first was better than starting the puzzle without sorting the pieces, because it's faster than looking for each piece as you need it.</i></p>



## Problem Solving Situation

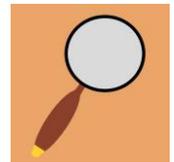
### Deserted Island

**Suggested Instructions:** After reading a book about being lost or taking a long journey, the teacher works with a group of children as each child attempts to solve a problem about surviving on a deserted island. The teacher prepares a table with a variety of materials to be used in the activity (e.g., paper and pencils) and says (instructions should be varied to reflect book read to children), "Think about how the character in our story survived when [he/she] was stranded. Let's pretend that you are going to be stranded on a deserted island. You can only bring what will fit in your backpack. What would you bring? First, we will work independently. Then, when we are all finished working, we will share our ideas with each other. You also should think about how you will share with the group." As each child works and records ideas (in whatever way the child chooses), the teacher carefully observes and makes notes about individual problem-solving abilities, paying attention to attempts and procedures to solve the posed problem, as well as which ideas are generated by which children and distinguishing them from decisions the group made together. The teacher might also create additional stations to build on this problem. The first optional station is for the novel problem of BUILDING something the child might need on an island: The teacher prepares a table by laying out a variety of materials that might be found on an island (e.g., banana leaves, palm fronds, coconut husks, twigs, and vines). The teacher says to the class, "When you're finished with the brainstorming activity, go to the table in the art center and build something you MIGHT NEED on the island." The second optional station is for the novel problem of MAKING something that shows what child's island must have: The teacher says to the class, "When you're finished with the brainstorming activity, make something that shows what your island MUST HAVE in order to meet your needs. Remember, to think about the different ways we can show our thinking. You can use materials from the art center. Once you have all the materials, work at your own (table/desk/seat)."

**Suggested Group Size:** Three to five children.

**Suggested Materials:**

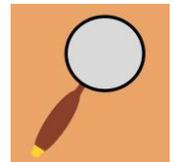
- A familiar grade-level-appropriate book about being lost or taking a long journey such as:
  - Are You My Mother? by P.D. Eastman
  - Polar Bear Night by Lauren Thompson
  - How I Became a Pirate by Melinda Long
  - Lost and Found by Oliver Jeffers - Corduroy by Don Freeman
  - I Lost My Tooth in Africa by Baba Diakite
  - The Buddy Files: The Case of the Lost Boy by Dori Butler
  - The Larry Gets Lost Series by John Skewes
  - A Path of Stars by Anne O'Brien
  - Mrs. Nelson Is Missing by Harry G. Allard Jr.



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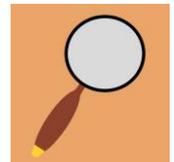
- Stuart Little by E.B. White
- A Wrinkle in Time by Madeleine L'Engle
- For the backpack activity, children must be provided with paper and writing implements at the beginning of the activity. Include a variety of writing/drawing implements of differing size/thickness to support all grips (e.g., primary pencils and no. 2 pencils, standard crayons and jumbo crayons, markers of different sizes) AND multiple types of paper (e.g., blank, lined, graph). Variety in materials will also support children's engagement in the activity.
- For optional station #1 for a novel problem of BUILDING something the child might need on an island, provide a variety of materials that might be found on an island (e.g., banana leaves, palm fronds, coconut husks, twigs, and vines) and a variety of construction materials (e.g., glue, string, tape).
- For optional station #2 for a novel problem of MAKING something that shows what the child's island must have, provide a variety of arts and crafts supplies (e.g., paper, crayons, markers, pipe cleaners/fuzzy craft sticks).

Skill	Examples
A. Acknowledges that a problem exists without attempting to solve it (this may manifest as a child moving away from the problem).	<i>Raziya says, "I'll never be alone on a deserted island. I don't know why we're doing this." Mr. Furr asks, "Do you have any questions about the activity?" Raziya replies, "No, I just want to do something else." She starts working on another assignment.</i>
B. Attempts to solve a problem by mimicking the motions and procedures of others OR seeking general support from others very early in the problem solving process (e.g., how do I do this? I don't know what to do.).	<i>Malinda mimics other children who are making lists. But Malinda makes a list that has nothing to do with supplies needed on a deserted island. When Mr. Furr asks, "How will you use those supplies on a deserted island?" Malinda responds, "I don't know. Everybody else was making a list, so I made one too."</i>  <i>Mr. Furr observes Quinan asking another child, "What's on your list? Can you help me with mine?"</i>
C. Attempts to solve a problem using random trial and error.	<i>Kennedy begins making a list of everything that she can think of in her bedroom that is small enough to fit in her backpack. She crosses out some items and circles others. Mr. Furr asks Kennedy why she is crossing some items off the list. Kennedy responds, "Right now I am just thinking of everything I can and crossing off what I do not want to bring."</i>  <i>Kathryn empties her backpack and begins walking around the room picking up items, putting them in her backpack, and then taking them out. When Mr. Furr asks what she is doing, Kathryn responds, "I am seeing what fits in my backpack. I wanted to bring my favorite game but it doesn't fit, so I'm looking for something else to bring."</i>
D. Solves OR attempts to solve a familiar problem using procedures learned in	<i>Karen says, "I'm just going to take my sleeping bag [not connecting the conceptual knowledge needed to solve the problem]. It's kind of big but I can fold it like we do with the school's flag so that it's really small and easier to get in a backpack." [previously learned procedure(s): folding to make things fit]</i>



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Skill	Examples
<p>previous problem solving experiences.</p>	<p><i>Joe says, "I can use Google to find out what I should bring." He goes to the class computer, types "google" in the URL field to bring up the Google page, and in the search field types, "What should I bring to a deserted island?" He clicks the first link on the list that comes up and copies down the items it describes, including a guitar, a boat, and a barbecue. Several of the items on Joe's list won't fit in his backpack or aren't necessary for surviving on an island [not connecting the conceptual knowledge needed to solve the problem]. [previously learned procedure(s): using a search engine]</i></p>
<p>E. Solves OR attempts to solve a novel problem using procedures learned in previous problem solving experiences without demonstrating knowledge of why the procedure is or is not successful.</p>	<p><i>Santiago explains to Mr. Furr that the real problem is that if he was on a deserted island, he would need to get home [novel problem of getting home]. Santiago then says, "I'm going to need a cell phone." When Mr. Furr asks Santiago if he thinks the cell phone will work on a deserted island, he says, "I don't know. My parents' cell phones always work [not demonstrating knowledge of why the procedure would or would not be successful; not connecting the conceptual knowledge needed to solve the problem]." [previously learned procedure(s): using a cell phone to call for help]</i></p> <p><i>Mr. Furr tells the class that when they're finished with the brainstorming activity they can go to the table in the art center and build something they might need on the island [novel problem of building something they might need]. A variety of materials that might be found on an island are laid out on the table, including banana leaves, palm fronds, coconut husks, twigs, and vines. Sarah goes to the table and uses the glue stick to glue banana leaves together as she's done with other art activities. The leaves do not stick together and Sarah says, "Why won't they stick together?" Sarah then gets another glue stick and keeps trying to glue the leaves together [not demonstrating knowledge of why the procedure would or would not be successful]. [previously learned procedure(s): using a glue stick]</i></p>
<p>F. States a hypothesis about how to solve a novel problem, using both concepts and procedures.</p>	<p><i>Alana writes, "I need to light a bonfire to attract the attention of a boat going by [novel problem of rescue]." Mr. Furr asks Alana to tell him more about her writing. Alana responds, "If I take matches it will be easier to light a fire and be seen if a boat comes by [hypothesis]." [previously learned procedure(s): building a fire] [concept: a fire can be used to create a signal for help]</i></p> <p><i>Gene tells Mr. Furr that he is going to take a cell phone on the deserted island. After Mr. Furr asks Gene if he thinks the cell phone will work, Gene realizes that he has a new problem, which is to have a way to connect to other cell phones [novel problem]. Gene says, "If I take the right stuff with me, I can use a tall tree as a tower [hypothesis]." [previously learned procedure(s): using a cell phone to call for help] [concept: cell phones need a way to connect]</i></p>
<p>G. Solves OR attempts to solve a novel problem by connecting concepts and using familiar procedures.</p>	<p><i>Chen makes a list of items to take to survive on the island AND to escape from the island [novel problem of escape]. Mr. Furr notices that one of the items has a slash (matches/campfire/rescue fire), and asks why. Chen says, "I don't have a lot of space in my backpack, so I need to take things that can be used in different ways." [concept: taking an item with multiple uses will save space for more items] [previously learned procedure(s): use text examples to support an answer; brainstorming by making a list]</i></p>



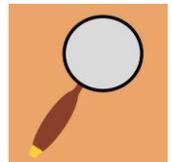
## Assessment Means Form: Problem Solving

Skill	Examples
	<p><i>Mr. Furr tells the class that when they're finished with the brainstorming activity they can go to the table in the art center and build something they might need on the island [novel problem of building something that might be needed on the island]. A variety of materials that might be found on an island are laid out on the table, including banana leaves, palm fronds, coconut husks, twigs, and vines. Chris begins to make something out of twigs. When Mr. Furr asks Chris what he is making, Chris says, "I'm making a raft out of these twigs. Because twigs float I thought I could make a raft to help me get off the island and back home." [concept: some materials float and are a better choice for building a raft] [previously learned procedure(s): building something using art materials]</i></p>
<p>H. Generates AND explains an alternate problem solving approach (including when an approach is not working).</p>	<p><i>Gervaise is making a picture list of the items he will take. When Mr. Furr asks Gervaise why he has crossed out his drawing of a flashlight [original solution], Gervaise says that he was going to take a flashlight, but realized the batteries could burn out, so a solar-powered lantern [new solution] is a better choice [explanation of an alternate approach based on concept that light needs a power source].</i></p> <p><i>Mr. Furr tells the class that when they're finished with the brainstorming activity they can go to the table in the art center and build something they might need on the island. A variety of materials that might be found on an island are laid out on the table, including banana leaves, palm fronds, coconut husks, twigs, and vines. There are also pictures of huts, boats, and rafts. Heidi makes a boat out of twigs [original solution]. When she tests out her boat, it immediately sinks. Madeline, who is working next to Heidi, says, "I don't think those twigs float well enough to make a boat." Madeline looks through the regular art materials, finds some straws [new solution], and says, "These look like the things used to build the boat in one of the pictures [one of the pictures shows a boat made of bamboo]. I think these might float better [explanation of an alternate approach based on the concept that some items float better than others]."</i></p>
<p>I. Generates AND explains multiple approaches for solving a problem.</p>	<p><i>Lily makes a note about ways to use the backpack. She includes hanging it up to catch rainwater, weighting it with rocks to anchor a kite being used as a rescue signal, constructing a trap to catch food, opening it up flat to make a hammock (using the straps to secure it to a tree), and using the straps to make sandals. When Mr. Furr asks Lily to tell him more about her note, Lily says, "There are lots of ways I can use my backpack on the island. I know I need water to live [conceptual knowledge] and I can use the backpack to catch rainwater for me to drink [procedural knowledge]." Lily then continues to explain each of the other uses of the backpack.</i></p> <p><i>Jasmin explains to Mr. Furr that the real problem is that if she was on a deserted island, she would need to get home [novel problem of getting home]. So, Jasmin makes a list of what she would need to solve this novel problem. On her list of items needed for getting home, Jasmin includes matches, a bright orange flag, rope, and a map. When Mr. Furr asks Jasmin to explain why she listed those items Jasmin says, "I'm bringing matches because I can use them to make a big fire [procedural knowledge] that will get the attention of boats going by the island [conceptual knowledge]. I'm bringing a bright orange flag because I can make it into a kite [procedural knowledge] to get the attention of boats and planes [conceptual knowledge]. Jasmin then continues to explain each of the remaining items on her list.</i></p>



## Assessment Means Form: Problem Solving

Skill	Examples
<p>J. Provides justification for why a chosen self- or peer-generated problem solving approach might be the most efficient one for solving a problem.</p>	<p><i>Maggie writes a story about what she will bring to survive on the island. In her story she writes about bringing a water filter. When Mr. Furr asks why she included the water filter, Maggie says, "At first I thought about bringing lots of bottles of water [less efficient approach] but they would be super heavy to carry, take up valuable space in the backpack, and eventually would run out. It would be better to take a water filter [efficient approach]. It's lighter and my supply of drinkable water would last longer than with a limited number of water bottles [justification]."</i></p> <p><i>Al first writes an extensive list of items: blanket, tarp, rope, duct tape, extra clothes, bottles of water, matches, flint, seeds, granola bars, chickens, rice, flashlight, cooking pot. Then he crossed several items off his list including: blanket, duct tape, extra clothes, bottles of water, matches. When Mr. Furr asks him about his list, Al says, "First I brainstormed. I wrote all the things I'd like to bring that were small enough to fit in a backpack. But all those things won't fit in my backpack at the same time so then I had to decide what was most important. I crossed off the things that I could live without. Like the bottles of water [less efficient approach]. Those take up a lot of space but if I have a pot [efficient approach], I can boil water on the island so that it's safe to drink. I'll bring a canteen full of water [efficient approach] instead that I can use to carry water from a stream to my camp and to hold water that I've already boiled. I crossed off the granola bars [less efficient approach] because I think the chickens are better. Chickens are small, they can eat bugs on the island, and they'll lay eggs that I can eat. I crossed off the flashlight [less efficient approach] because it has batteries that will run out. I crossed out the matches [less efficient approach] because they'll run out too. A flint will let me light fires for light and cooking for a long time. I really wanted to bring a blanket [less efficient approach] but it will take up a lot of space. I'll wear a jacket and use that as a blanket instead.</i></p> <p><i>Maria's list includes matches, a pot, a bed sheet, fishing line and hooks, rope, a large container for water, a map, and a compass. When Mr. Furr asks her why she has a bed sheet on her list Maria says, "I think the most important thing will be to try to get home. So, I'm not bringing things to help me live on the island; instead I'm bringing things to help me get home. It might be a long way so I won't be able to row the whole way and a motor for a boat won't fit in my backpack. So, I'm going to bring a sheet that I can use to make a sail for a sailboat.</i></p>



## Problem Solving Situation

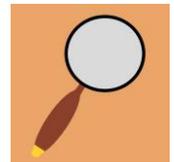
### Building a Bridge

**Suggested Instructions:** After reading the book and/or viewing a video of *The Three Billy Goats Gruff*, the teacher works with a group of children as each child attempts to build a bridge. The teacher prepares a table with a variety of materials to be used in the activity (e.g., building materials, pictures of bridges) and poses the following problem to the group: "I want you to build a bridge with the materials that are here on the science table. This bridge, when you are finished, must be able to stand up on its own, without you holding it, and support the third billy goat figure and the troll figure at the same time." The teacher shows the goat and troll figures. "When you are finished, use these figures to see if your bridge will support both of these characters at the same time." As children build their bridges, the teacher carefully observes and makes notes about the children's problem-solving abilities, paying attention to attempts and procedures used to solve problems.

**Suggested Group Size:** Three to five children.

**Suggested Materials:**

- A familiar grade-level-appropriate book in which building is an important element, such as:
  - *The Three Billy Goats Gruff*
  - *Building a House* by Byron Barton
  - *The Three Little Pigs*
  - *Rapunzel*
  - *The Borrowers* by Mary Norton
  - Books with castles or forts as settings
  - *Magic Tree House* books by Mary Pope Osborne
  - *Roberto, the Insect Architect*, by Nina Laden
  - *If I Built a House* by Chris Van Dusen
  - *Rosie Revere, Engineer* by Andrea Beaty
  - *The Wonderful Wizard of Oz* by L. Frank Baum
  - *Mr. Ferris and His Wheel* by Kathryn Gibbs Davis
  - *The Mighty Mars Rovers* by Elizabeth Rusch
  - *Iggy Peck, Architect* by Andrea Beaty



## Assessment Means Form: Problem Solving

- Materials to use for building (e.g., interlocking plastic blocks, pieces of corrugated and flat cardboard, small empty boxes, cardboard and plastic tubes, Styrofoam blocks, foam peanuts, other donated materials). Both large and small building materials should be included so that children with fine motor difficulties can participate. Variety in materials will also support children's engagement in the activity.
- Adhesives (e.g., tape, glue, low-temperature glue guns, staplers and staples)
- Pictures of bridges

Skill	Examples
A. Acknowledges that a problem exists without attempting to solve it (this may manifest as a child moving away from the problem).	<i>Steven looks at the available materials and says, "These aren't the things I like to build with. I have better building toys at home." When the teacher tells Steven that these are the only materials available, he begins moving the materials around on the desk without attempting to solve the problem.</i>
B. Attempts to solve a problem by mimicking the motions and procedures of others OR seeking general support from others very early in the problem solving process (e.g., how do I do this? I don't know what to do.).	<i>Laronda watches a friend gather materials and gathers the same materials for herself. She sits near her friend and builds something similar to what her friend is building, but when Mr. George asks Laronda how she is going to build her bridge, Laronda says, "I don't know. I like the way she's stacking her materials, so I'm trying to copy hers."</i>  <i>Sam gathers materials for building, but before he begins, he asks Mr. George, "Can you help me? I can't make the bridge stand up."</i>
C. Attempts to solve a problem using random trial and error.	<i>Caleb gathers several small blocks of different shapes and begins stacking them. When they fall over, he tries stacking them again, this time with different shapes on the bottom. Caleb keeps trying to stack the blocks over and over but is unable to create a stack that will stay up.</i>
D. Solves OR attempts to solve a familiar problem using procedures learned in previous problem solving experiences.	<i>Shana says, "This was so much fun when we did it last week," and chooses all of the plastic interlocking blocks that are available to build her bridge. However, there are not enough to build a bridge large enough for both characters, and Shana is unable to combine other materials with the blocks she has already used.</i>
E. Solves OR attempts to solve a novel problem using procedures learned in previous problem solving experiences without demonstrating knowledge	<i>Siri uses a LOT of masking tape to wrap her popsicle stick bridge. When Mr. George asks her why she needed so much tape, Siri says, "I've never had to build a bridge to hold something. We have to use lots of tape to hold posters on the wall, so I hope that will be enough to hold the characters!" When Siri tries the goat and troll on the bridge, it collapses, and Siri says, "I don't get it. Using a lot of tape works for posters."</i>



## Assessment Means Form: Problem Solving

Skill	Examples
of why the procedure is or is not successful.	
F. States a hypothesis about how to solve a novel problem, using both concepts and procedures.	<i>Jackie gathers materials in pairs: two identical rectangular cereal boxes, two round oatmeal boxes, etc. When Mr. George asks her why she has chosen two of everything, Jackie says, "I think that if the bridge is going to hold both figures, it has to be balanced on each side. I remember when we were building towers for Rapunzel, the blocks on the base were different and it collapsed."</i>
G. Solves OR attempts to solve a novel problem by connecting concepts and using familiar procedures.	<i>Jarmone builds his bridge with a support at the middle of the bridge. He tests the bridge with the goat and troll figurines, and it works. Mr. George asks Jarmone to tell the class about his bridge. Jarmone says, "I've never had to build a bridge to hold something. When I first tried to build the bridge, I didn't have the support in the middle. When I tested it out, the bridge collapsed. Then I remembered that when the bookshelf was sagging in the middle from having too many books, the custodian fixed it by adding a board in the middle to support the weight. I decided to do the same thing for my bridge, and it worked!"</i>
H. Generates AND explains an alternate problem solving approach (including when an approach is not working).	<i>Mandy builds a bridge with popsicle sticks and lots and lots of masking tape, but it does not hold the weight of the goat and troll. She tries again using plastic cups, wooden rulers, and masking tape. Her new bridge holds the weight of the goat and troll. When Mr. George asks her what worked with the second bridge that didn't work with the first, Mandy explains that the popsicle sticks weren't strong enough, but the rulers are, and that the plastic cups add stability.</i>
I. Generates AND explains multiple approaches for solving a problem.	<i>Before beginning to build, Joe gets some paper and sketches some ideas. Mr. George checks in with Joe and asks him to explain his ideas. Joe says, "My first idea is rulers laid across the space between two desks. The second idea is two chairs back-to-back, with a big book across the tops. The third one is my friends using their bodies to make a bridge for the goat and the troll. I think any of these will work because they are all strong enough to hold the goat and the troll."</i>
J. Provides justification for why a chosen self- or peer-generated problem solving approach might be the most efficient one for solving a problem.	<i>Julio builds a strong bridge in a short time; it holds the goat and troll figurines and does not use many materials. Mr. George asks Julio, "Why do you think this was the best way to solve this problem?" Julio responds, "I chose larger materials because they are stronger and more stable, and using smaller pieces takes a lot longer. I used tape instead of glue because tape holds things together like glue but can also be wrapped around weaker areas to provide support."</i>

**NOTE: There is no Task for this Construct**